REGIONAL GROUNDWATER FLOW MODEL OF THE TUCSON ACTIVE MANAGEMENT AREA TUCSON, ARIZONA: SIMULATION AND APPLICATION

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Dale A. Mason and Liciniu Bota
Hydrology Division
Phoenix, Arizona
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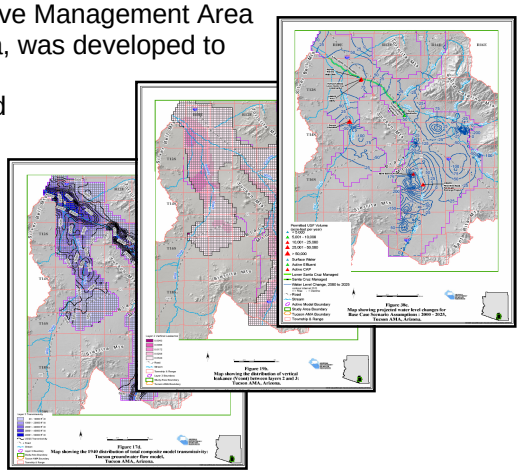
Abstract

A numerical groundwater flow model of the Tucson Active Management Area (AMA) in Pinal, Pima and Santa Cruz Counties, Arizona, was developed to simulate the regional hydrologic system during a pre-development (steady-state) period of 1940, a developed (transient) period from 1941 to 1999, and for a projection period from 2000 to 2025. The upper and lower basin-fill alluvium in the Tucson AMA forms a complex regional aquifer system that is divided into 3 model layers.



The steady-state groundwater conditions indicate inflows into Tucson AMA include 34,425 acre-feet of mountain-front recharge, 39,445 acre-feet of stream infiltration, and 24,155 acre-feet of groundwater underflow. Steady-state outflows consisted of 59,695 acre-feet of pumpage, 17,170 acre-feet of evapotranspiration, and 21,191 acre-feet of groundwater outflow. Groundwater underflow within the Tucson AMA from the Upper Santa Cruz (USC) sub-basin to the Avra Valley sub-basin was about 14,580 acre-feet. Transient model results indicate a cumulative loss of 6.9 million acre-feet of water from the regional aquifer between 1941 and 1999. Transient outflows were simulated as 15.9 million acre-feet of groundwater pumpage and natural outflows of about 1.5 million acre-feet; simulated inflows included about 4.0 million acre-feet of incidental recharge from agricultural and industrial sources and about 6.5 million acre-feet of natural inflows. Simulated irrigation recharge ranged from 33 percent of total irrigation pumpage in the 1940s and 1950s, to 25 percent of pumpage in the 1980s and 1990s.

The transient model simulated both the widespread, long-term water level declines in agricultural areas of the northern Avra Valley sub-basin and recoveries in the area since the mid-1970s. The model also simulated the historic overdrafting of large areas of the regional aquifer in the USC sub-basin, which has resulted in long-term water level declines throughout much of the sub-basin during the transient period. Observed and simulated water level recoveries in the USC sub-basin are generally limited to areas along the Santa Cruz River and its tributaries where flood flows provided sufficient recharge to offset local pumpage.

The results of a Base Case projection simulation from 2000 to 2025 that maximized the utilization of renewable water supplies indicates that the Tucson AMA will not achieve its goal of reaching “Safe Yield” by 2025. However, the AMA-wide annual overdraft is projected to be between 14,000 and 20,000 acre-feet. The Avra Valley sub-basin will have a net increase in storage during the Base Case projection of about 453,000 acre-feet and water levels are projected to continue to recover due to extensive artificial recharge of renewable water and projected declines in agricultural pumpage. The Upper Santa Cruz sub-basin will experience a net loss of storage of

1,000,000 acre-feet; however, water levels are projected to rise in the City of Tucson's central wellfield area, T 14 S, R 14 E, for the period 2000 to 2020. The projected recovery is due to dramatically reduced withdrawals as pumpage is shifted to recovery of renewable supplies from recharge projects. After 2020, the water level recovery in the central wellfield is projected to slow as increasing municipal demand is satisfied by increased pumpage. Water levels in the southern areas of the basin near the Santa Cruz River are projected to rise due to recharge projects. However, water levels are projected to decline by between 50 to 225 feet in the eastern and southeastern areas of the Tucson AMA where demand is expected to be satisfied by nonrenewable groundwater.